204777

29P

NASA Technical Memorandum

NASA TM-108435

(NASA-TM-108435) MAMS DATA FOR THE CONVECTION AND MOISTURE EXPERIMENT (CAMEX) (NASA) 29 p

N94-24080

Unclas

G3/47 0204777

MAMS DATA FOR THE CONVECTION AND MOISTURE EXPERIMENT (CAMEX)

By A. R. Guillory, G. J. Jedlovec, and R. J. Atkinson

Space Sciences Laboratory
Science and Engineering Directorate

January 1994

National Aeronautics and Space Administration
George C. Marshall Space Flight Center

MSFC - Form 3190 (Rev. May 1983)

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
January 1994

3. REPORT TYPE AND DATES COVERED
Technical Memorandum

4. TITLE AND SUBTITLE
MAMS Data for the Convection and Moisture Experiment (CAMEX)

5. FUNDING NUMBERS

6. AUTHOR(S)
A. R. Guillory, G. J. Jedlovec, and R. J. Atkinson*

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
National Aeronautics and Space Administration
Washington, D.C. 20546

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
NASA TM-108435

11. SUPPLEMENTARY NOTES
Prepared by Space Sciences Laboratory, Science & Engineering Directorate.
*Martin Marietta Corporation

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Unclassified--Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

During the fall of 1993, NASA sponsored a field program called the Convection And Moisture Experiment (CAMEX). The field effort focused on: (1) convective storms in order to investigate their associated electrical properties, precipitation, and predictability, and (2) atmospheric moisture studies. This document describes the data collected from the Multispectral Atmospheric Mapping Sensor (MAMS) onboard a NASA ER-2 aircraft which was deployed out of NASA/Wallops Flight Facility, Wallops Island, Virginia, from September 11 through October 7, 1993.

14. SUBJECT TERMS
CAMEX, MAMS, Remote Sensing, Meteorology, Multispectral Imagery, Moisture, Water Vapor

15. NUMBER OF PAGES
30

16. PRICE CODE
NTIS

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)

ACKNOWLEDGMENTS

This work was performed under the Physical Climate and Hydrologic Systems research program at NASA Headquarters. The support of the MAMS flights for CAMEX by Dr. Ramesh Kakar is greatly appreciated. The collection of the MAMS data was also possible because of the dedicated efforts of various NASA/Ames Research Center personnel, including the instrument technicians, ER-2 flight crew, and pilots.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

TECHNICAL MEMORANDUM

MAMS DATA FOR THE CONVECTION AND MOISTURE EXPERIMENT (CAMEX)

INTRODUCTION

During the Fall of 1993, NASA sponsored a field program called the Convection And Moisture EXperiment (CAMEX). The scientific objectives of the experiment were as follows: (1) to acquire "measurements of temperature, water vapor, clouds, precipitation, and electrical fields associated with tropical convection," (2) to acquire "radiometric signatures of clear air and precipitation at high incidence angles," (3) to acquire "SSM/T-2 instrument validation and calibration," (4) to study the "high resolution vertical and horizontal measurement of the temperature and moisture field as well as top of the atmosphere radiances over WFF (Wallops Flight Facility)," and (5) to conduct an "in-depth study of low-level vertical temperature and moisture gradients and their relation to anomalous propagation" (Griffin et al. 1994). The field phase was conducted from September 7 through October 7, 1993.

One of NASA's roles in CAMEX was to collect aircraft remote sensing measurements during the program and to participate in research supporting the use of these measurements to address the specific CAMEX objectives. The ER-2 high-altitude aircraft was used with a suite of advanced visible, infrared, and microwave instruments to measure temperature, humidity, precipitation, and atmospheric electric fields. These measurements were to demonstrate prototype observing capabilities and to study the structure and dynamics of convective storms and mesoscale events. This report highlights one of the seven instruments flown on the ER-2, namely, the Multispectral Atmospheric Mapping Sensor (MAMS). Other instruments flown on the ER-2 include the Advanced Microwave Precipitation Radiometer (AMPR), the ER-2 Doppler Radar (EDOP), the High-Resolution Interferometer Sounder (HIS), the Lightning Instrument Package (LIP), the Millimeter Imaging Radiometer (MIR), and the Millimeter-Wave Temperature Sounder (MTS).

Several aircraft sensors were developed by NASA in the mid 1980's to verify data from new satellite sensors and to collect unique datasets which would serve to justify future space-based instruments on low-Earth and geostationary observation platforms. In 1985, the MAMS was developed and flown to verify small-scale water vapor features observed in Visible Infrared Spin Scan Radiometer (VISSR) Atmospheric Sounder (VAS) imagery aboard the Geosynchronous Operational Environmental Satellites (GOES). This aircraft sensor provided an opportunity to independently verify single-pixel variations observed in the VAS channels (Menzel et al. 1986). This verification continued for several years providing useful correlative measurements (Jedlovec et al. 1986a; Moeller et al. 1989, 1993).

More recently, NASA developed the MODIS Airborne Simulator (MAS) to provide preliminary data and to underfly the EOS (Earth Observing System) MODIS instrument to be launched in the late 1990's (King and Herring 1992). While MAS provides unique spectral channels in which to study atmospheric moisture variations, the MAMS has consistently shown better relative and absolute calibration stability and signal-to-noise values than MAS (Jedlovec 1992; Jedlovec et al. 1989). Because of this, MAMS was used in CAMEX to address the horizontal moisture retrieval objective of CAMEX.

SCIENCE AND DATA COLLECTION OBJECTIVES

In addition to the aircraft instruments, CAMEX involved several ground-based instruments that were located near Wallops Island, Virginia. These instruments included a Raman lidar, Ground-Based HIS (GBHIS), CLASS, and conventional rawinsonde sites. The primary purpose for these instruments was to serve as ground truth for the aircraft instruments. Thus, the MAMS objectives reflect the availability of these data for "ground truthing."

The primary science objectives with MAMS for CAMEX were to: (1) intercompare HIS and MAMS data along the flight track for an extended region for variability assessment and integrated water content (IWC) retrieval comparison, (2) use HIS and MAMS data surrounding the Raman lidar to provide a three-way intercomparison/validation of water vapor signatures, (3) use ground truth rawinsonde information for absolute verification and algorithm assessment/improvement, and (4) obtain cloud top temperature and structure information in support of the microwave measurements. To achieve the first three objectives, the ER-2 made several flights over Wallops Island and the adjacent land and ocean. The final objective was achieved by flying several missions dedicated to convection.

The MAMS 6.5 μm channel has been used to map variations in upper tropospheric water vapor associated with a variety of atmospheric disturbances (Menzel et al. 1986; Jedlovec 1984; Jedlovec et al. 1986b). The split-window channels at 11 and 12 μm allow surface temperature estimations and the determination of total-integrated water content (IWC) in a column of the atmosphere as discussed by Jedlovec (1987, 1990) and Guillory et al. (1993). In particular, the split-window channels will be used to monitor water vapor variability in the vicinity of Wallops Island. This will be achieved by computing IWC over Wallops Island for several flights and comparing the derived values to those from the HIS, the Raman lidar, rawinsondes, and the GBHIS. Furthermore, comparisons can be made with HIS during any portion of the flight.

Previous investigations portray the utility of remotely sensed IWC. Bradshaw and Fuelberg (1993) compared MAMS and HIS IWC. Guillory et al. (1993) compared rawinsonde-, VAS-, and MAMS-derived IWC. Both studies found reasonable agreement in their comparisons and were able to relate relatively high IWC values to the formation of clouds. Jedlovec and Carlson (1994) evaluated the performance of the Physical Split Window (PSW) technique for deriving IWC, which is described in Guillory et al. (1993). Their evaluation suggests a poorer performance at night due to a lower air/land temperature contrast. Since most of the CAMEX missions were flown at night, they provide an excellent opportunity to further investigate the nighttime results. Guillory and Jedlovec (1994) applied the PSW algorithm to MAMS data from August 6, 1991. They analyzed the moisture field in and around a Florida sea-breeze front. Their analysis (not shown) depicts subtle, but significant, gradients (~4 mm/10 km) marking the frontal boundary. These gradients were verified by data from the University of Wyoming King Air aircraft, which made in situ measurements across the front. This work illustrates that the PSW procedure as applied to MAMS is capable of depicting subtle changes in the low-level moisture field. Therefore, the CAMEX dataset will provide a unique opportunity to evaluate nighttime split-window capabilities and to further investigate meso-γ scale water vapor variability.

INSTRUMENT DESCRIPTION

MAMS is a multispectral scanner which measures reflected radiation from the Earth's surface and clouds in eight visible/near-infrared bands, and thermal emission from the Earth's surface, clouds, and atmospheric constituents (primarily water vapor) in four infrared bands (Table 1). The 5.0 mRa aperture of MAMS produces an instantaneous field-of-view (IFOV) resolution of 100 m at nadir from the nominal ER-2 altitude of 20 km. The width of the entire cross path field-of-view scanned by the sensor is 37 km, thereby providing detailed resolution of atmospheric and surface features across the swath width and along the aircraft flight track. For clouds and thunderstorm features the IFOV decreases with increasing cloud height by a factor of (Z-20)/20, where Z is the cloud height in kilometers. Further details about MAMS may be found in Jedlovec et al. (1986a, 1989) and Jedlovec and Atkinson (1993).

The split-window channels from MAMS are similar to those from the Advanced Very High Resolution Radiometer (AVHRR), VAS, and GOES I-M imager and sounder (Fig. 1). The 11 μm channels of MAMS and VAS are very similar, while those of AVHRR and the GOES I-M imager and sounder are narrower and shifted toward shorter wavelengths. The 12 μm channel of AVHRR is positioned near 11.8 μm with a bandwidth about twice that of MAMS and VAS (which are centered at longer wavelengths). The GOES I-M imager and sounder 12 μm channels are also narrow when compared to AVHRR. One of the sounder 12 μm channels and the imager 12 μm channel are centered near 12.0 μm, while the other sounder channel is near 12.7 μm. These 12 μm channels measure upwelling radiation where water vapor and other constituent absorption (particularly, by the Q-branch of CO_2 at 12.63 μm) are more significant. The spectral differences of the 12 μm channels produce small differences in brightness temperatures for VAS and MAMS, but somewhat larger differences between AVHRR and MAMS (or VAS).

CAMEX DATA

Flights

The NASA ER-2 aircraft flew in support of the CAMEX field program from September 15 through October 5, 1993. The plane was deployed out of NASA/Wallops Flight Facility in Wallops Island, Virginia. Table 2 lists all the ER-2 CAMEX related flights. Figure 2 shows the location of the aircraft flight tracks for each mission. The date, flight

Table 1. MAMS channel configuration

Visible		Infrared		
Channel	Wavelength (μm)	Channel	Central Wavelength (μm)	Bandwidth @50% response
1	0.42 - 0.45	9	6.54	6.28 - 6.98
2	0.45 - 0.52	10	11.12	10.55 - 12.24[1]
3	0.52 - 0.60	11	11.12	10.55 - 12.24[1]
4	0.60 - 0.67	12	12.56	12.32 - 12.71
5	0.63 - 0.73			
6	0.69 - 0.83			
7	0.76 - 0.99			
8	0.83 - 1.05			

[1]Different channel gain and offsets.

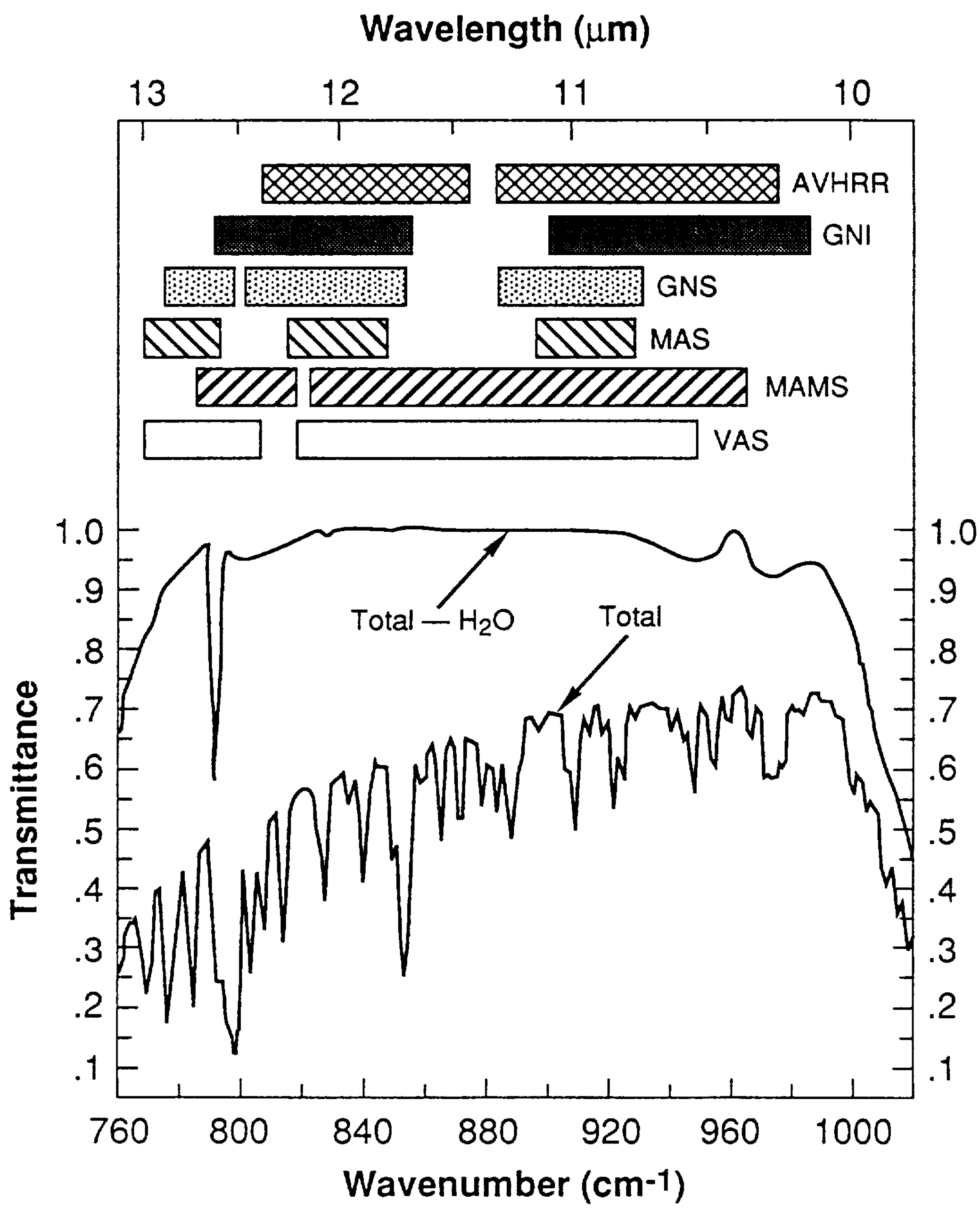
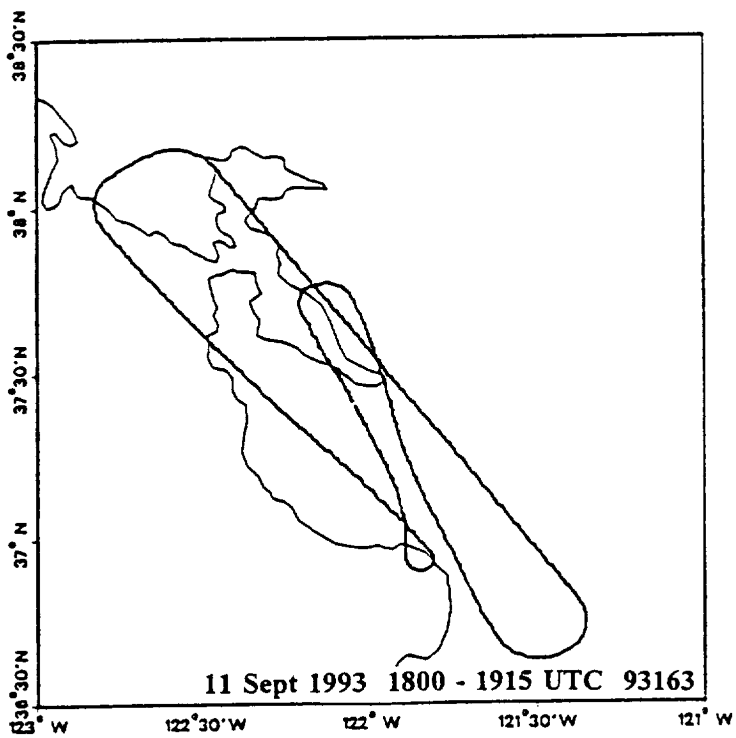


Figure 1. Spectral transmittance in the 10 - 13 μm region.

Table 2. CAMEX-related ER-2 flight

		Flight		Region	Objective
Day	Date	Number	Time (UTC)		
Sept. 11	93254	93163	1800 - 1915	CA, Pacific Ocean	Test Flight
Sept. 12	93255	93164	2000 - 0300	------	Ferry to Wallops/Water Vapor
Sept. 15	93258	93165	2005 - 2135	VA, MD, DE, NJ, Atlantic Ocean	SSM/T-2 Underflight
Sept. 19	93262	93166	2000 - 2215	VA, MD, Atlantic Ocean	Ocean Convection
Sept. 25	93268	93167	1610 - 1825	NC, VA, MD, Atlantic Ocean	Aircraft Test Flight
Sept. 26	93269	93168	1900 - 2340	VA, MD, DE, Atlantic Ocean	Ocean Convection/Water Vapor
Sept. 29	93272	93169	0100 - 0500	VA, DE, MD, Atlantic Ocean	AIRS (Water Vapor) mission
Sept. 30	93273	93178	2000 - 0220	VA, MD, DE, NJ, MA, GA, NC, Atlantic Ocean	SSM/T-2 Underflight/Water Vapor
Oct. 3	93276	94001	2000 - 0330	FL, NC, VA, MD, DE, Gulf of Mexico, Atlantic Ocean	Ocean Convection/Water Vapor
Oct. 5	93278	94002	1600 - 2340	FL, GA, SC, NC, VA, Atlantic Ocean	Ocean Convection
Oct. 7	93280	94003	1355 - 2010	------	Ferry to Ames



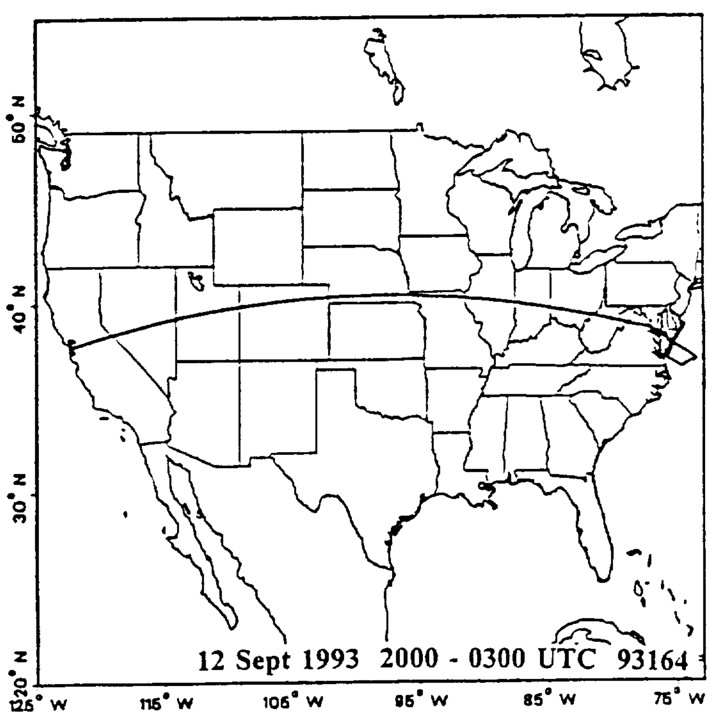
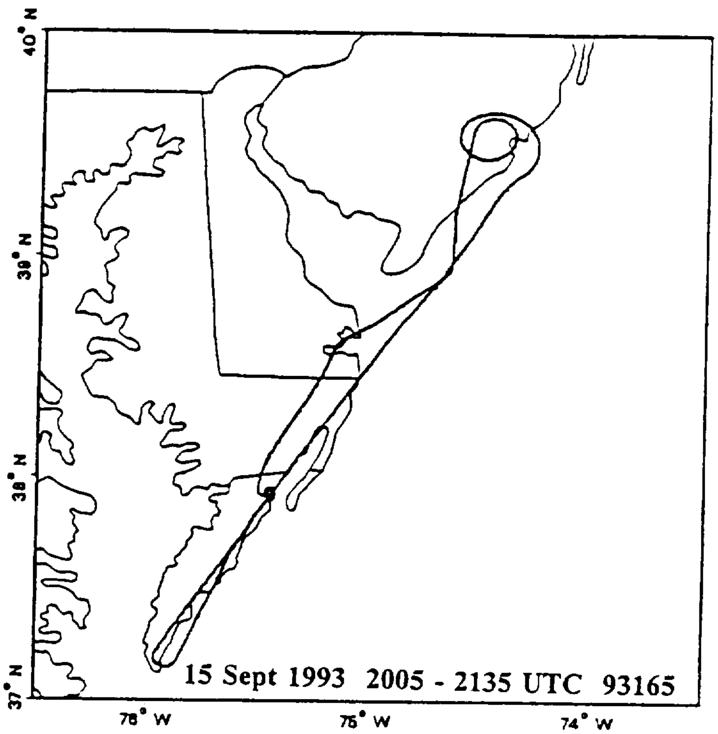


Figure 2. Flight track maps for ER-2 CAMEX missions.



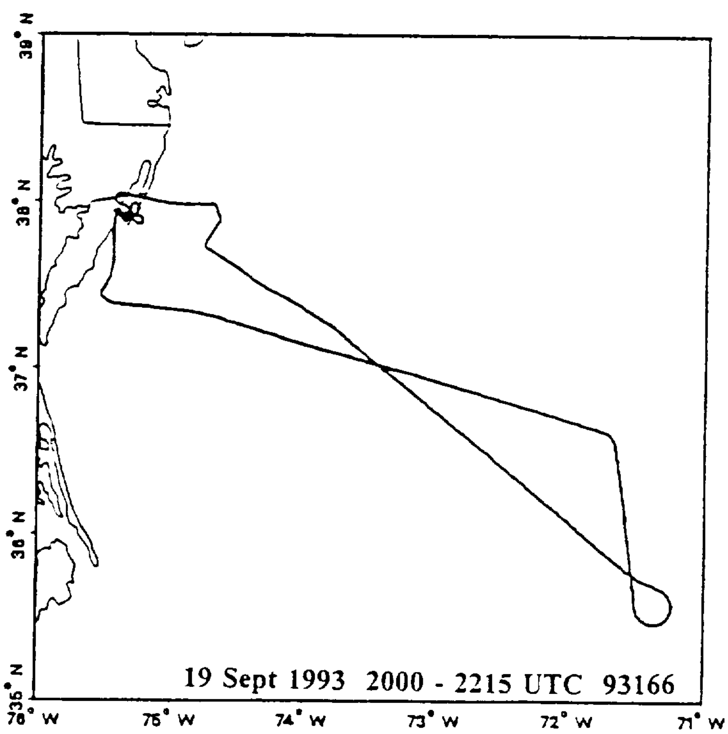
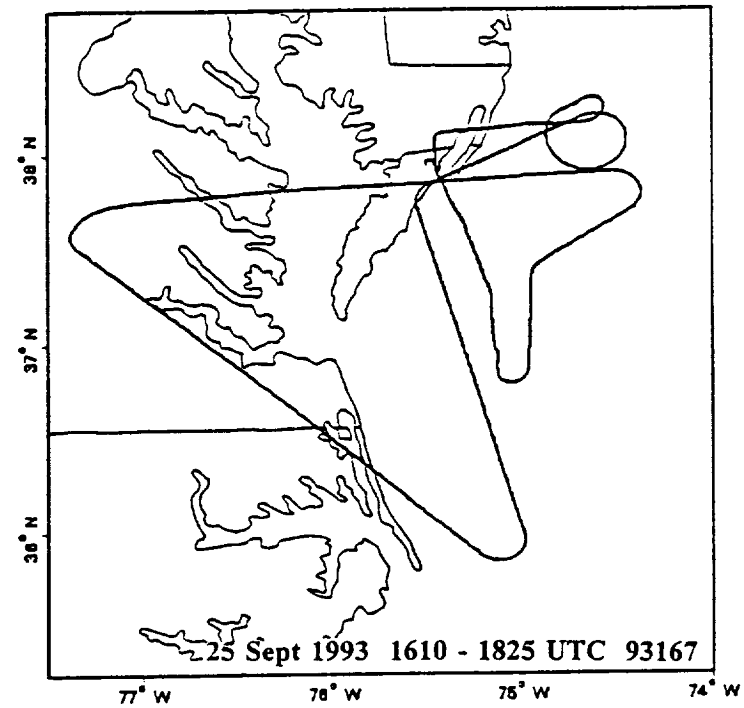


Figure 2. (continued)



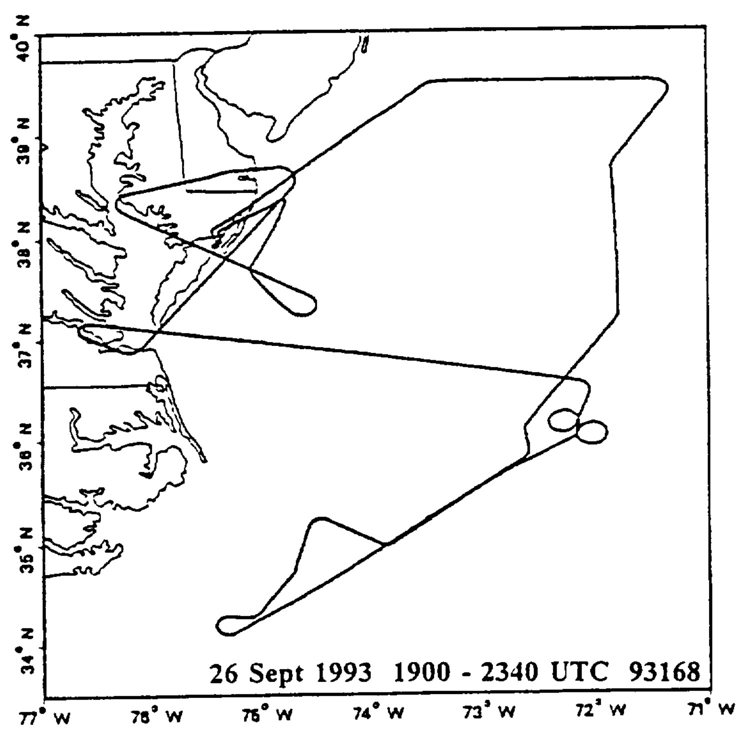
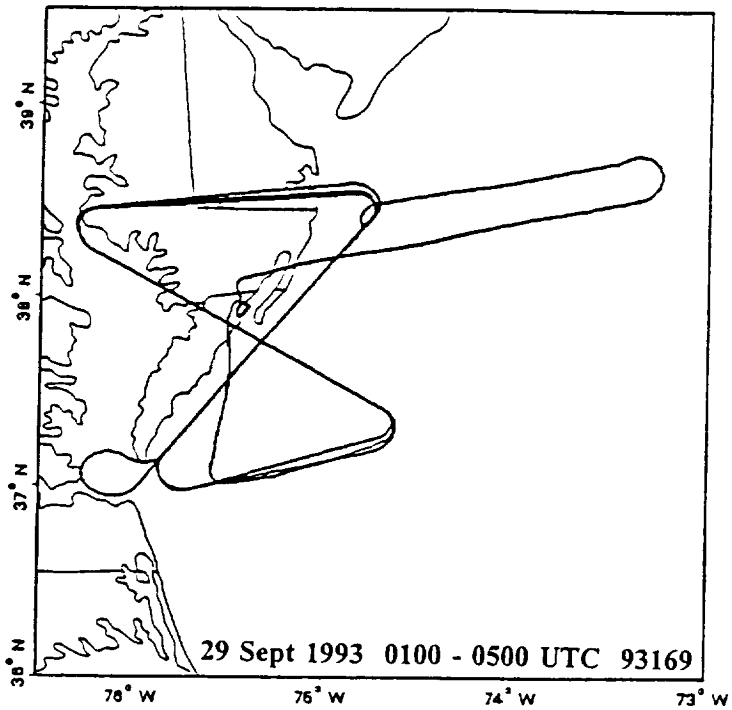


Figure 2. (continued)



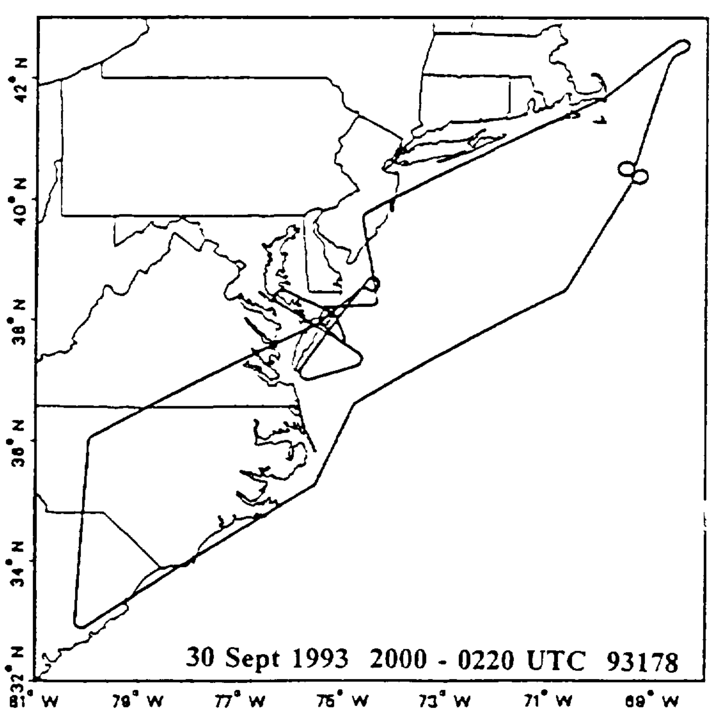


Figure 2. (continued)

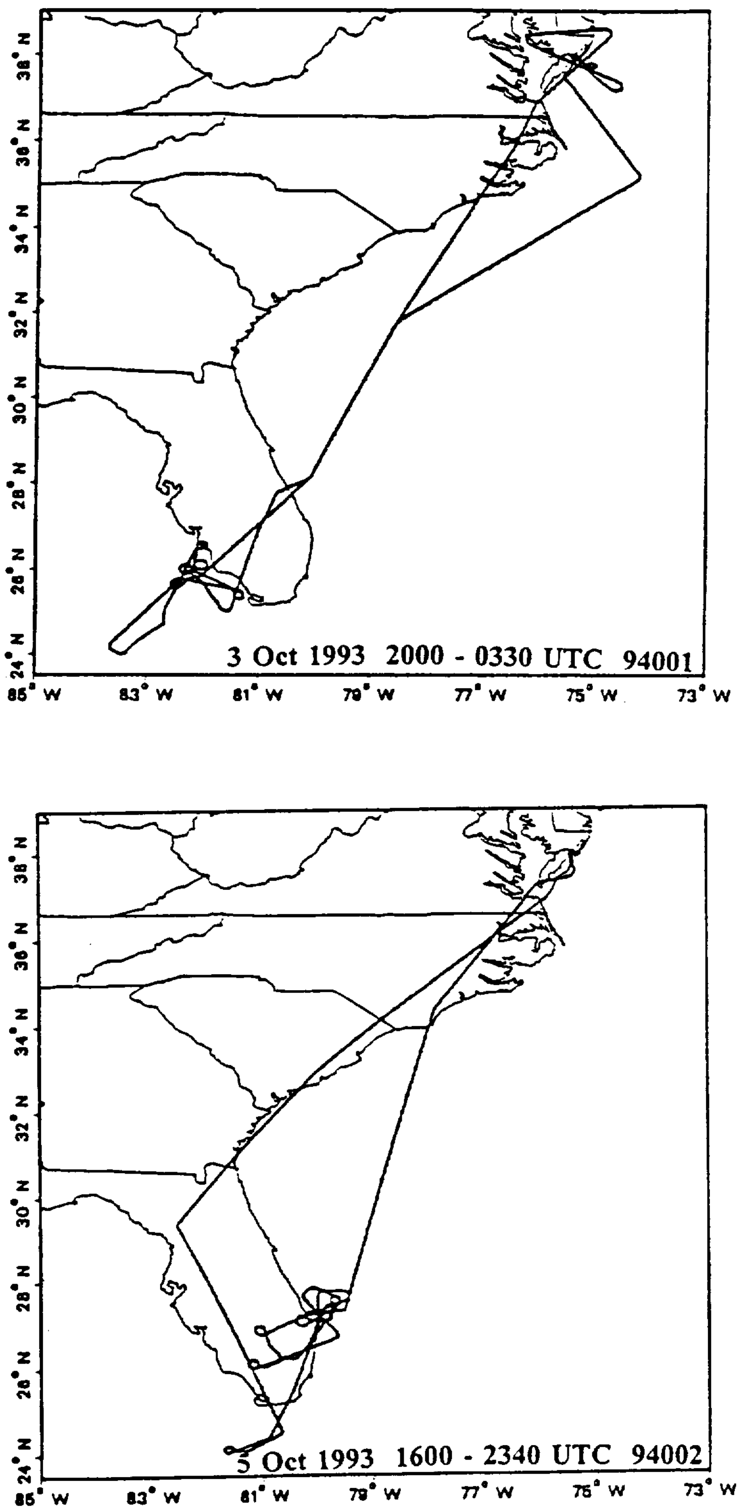


Figure 2. (continued)

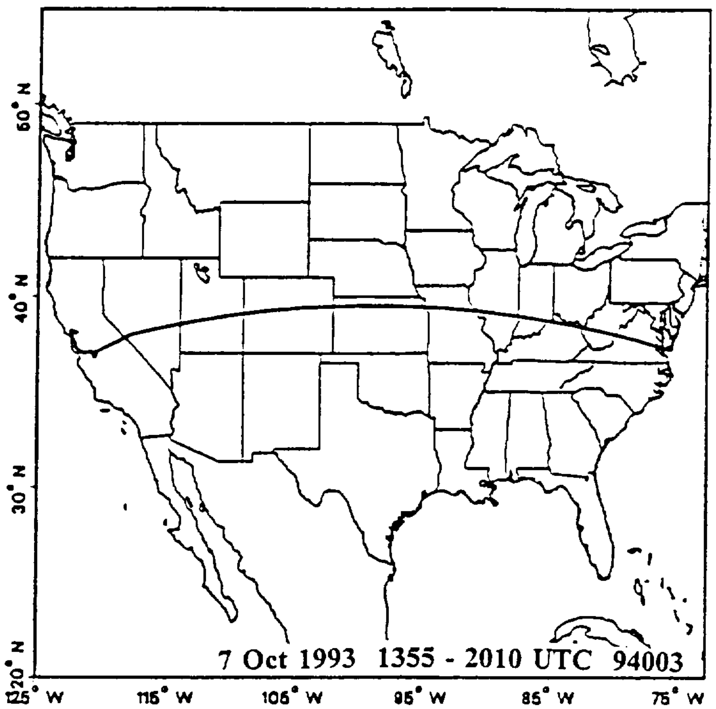


Figure 2. (concluded)

numbers, and times are included in the legend of each map in Fig. 2. The flight tracks were designed to meet the specific objectives of that mission as well as provide overpasses of Wallops at the end of each flight to meet the water vapor goals. MAMS was turned on after the ER-2 attained an altitude of ~55,000 feet, which is reached ~30 minutes after takeoff. It was turned off ~30 minutes (at ~55,000 feet) prior to landing. Figure 3 illustrates MAMS data for a flight leg over the ground-based sites (A=CLASS site, B=lidar and GBHIS, C=conventional rawinsonde site, D="The Chessie" [a boat]). Flights on September 11, 15, and 19 were aborted due to aircraft-related failures.

Data Quality

The utility of a dataset to meet a specific science objective is highly dependent on data quality and whether the dataset captured the phenomenon of interest. Instrument data quality is a function of a number of factors including instrument noise (both random and systematic), quality of the calibration data (directly affects relative and absolute calibration accuracy), appropriateness of channel gain/offset settings (affects channel sensitivity and dynamic range), amount of missing data, and other data peculiarities. In general, the MAMS data quality is good; however, no data were collected on the ferry flight from NASA/Ames (September 12) and on the AIRS (Atmospheric Infrared Sounder) mission (September 29) due to instrument-related failures.

The visible data for these flights are of good quality. However, only limited visible data are available, since most of the CAMEX missions took place in the late afternoon and evening. The gain settings in the visible channels were optimized to view clouds or land. By setting the gains this way, some saturation occurred on bright objects (e.g., clouds) in some channels.

The data quality of the infrared channels is of principal importance to the MAMS objectives for CAMEX, since they are used to derive atmospheric parameters. The sensitivity of each channel to variations in scene brightness temperature and dynamic range of the data is controlled by the channel gain and offset. For MAMS these values must be preset. This is often a difficult task because the flight temperature of the instrument often affects the performance of the electronics controlling these values. The expected dynamic range of the data is also often quite large which limits sensitivity of the 8-bit MAMS data. Although 10-bit analog-to-digital boards are used, the current MAMS datastream does not permit the storage of these 10-bit data in a conventional fashion. For the CAMEX flights, the infrared channels of MAMS were recorded at 10-bit resolution by using the MAMS "re-router" board (Jedlovec et al. 1989). This printed wiring board effectively re-routes the least significant bits (lsb's, bits 9 and 10) of channels 9-12 to the channel 1 datastream. These lsb's are recombined with their 8-bit counterparts during post-processing to create 10-bit data. The collection and reconstruction of the 10-bit data allows for an effective four-fold increase in channel sensitivity (over 8-bit data) in the infrared channels without sacrificing dynamic range. Thus, the gains can be set to cover a large dynamic range and still have the required sensitivity in the infrared channels.

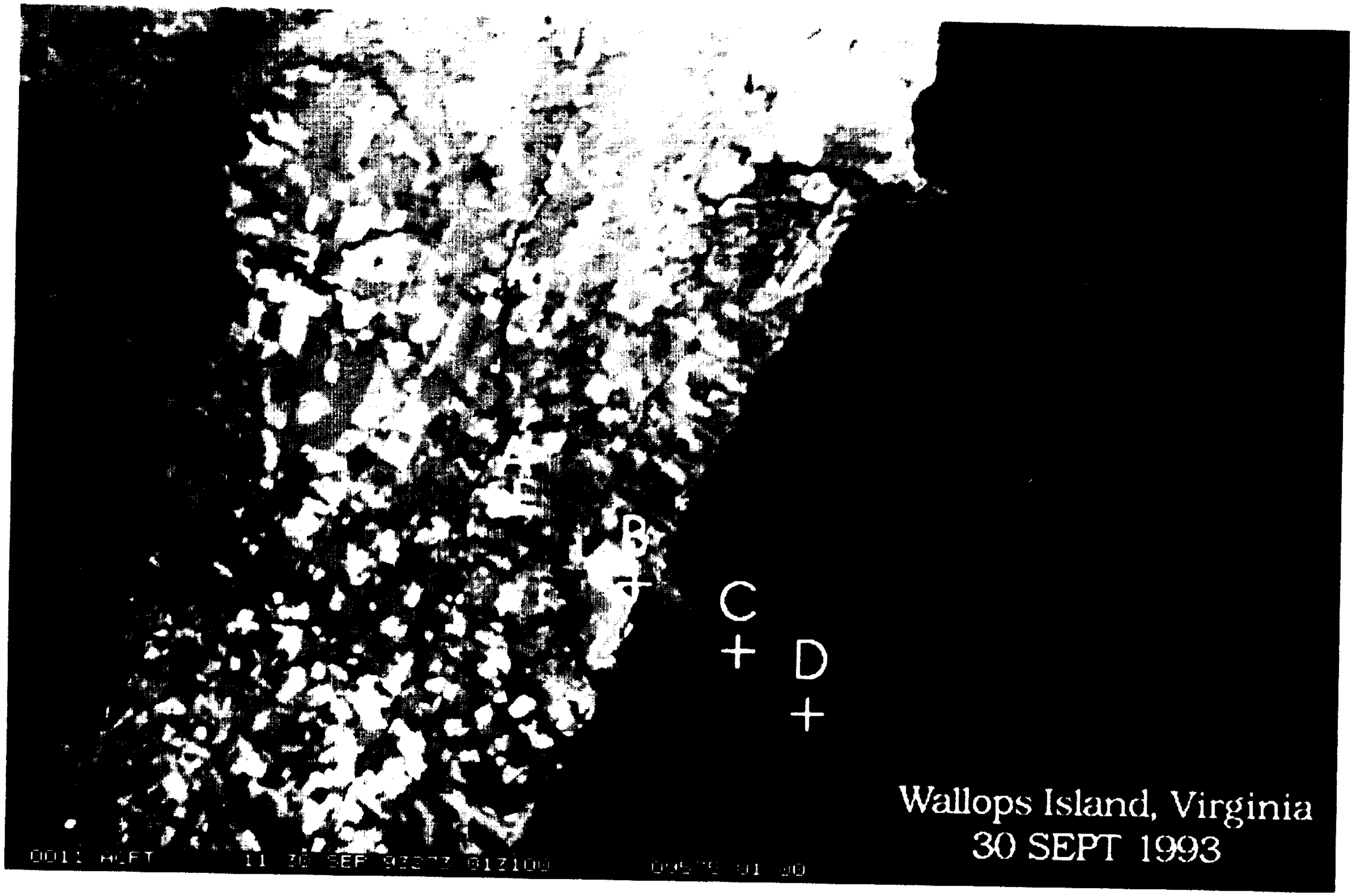


Figure 3. MAMS image of Wallops Island, Virginia with ground-based instrument sites indicated.

Table 3 presents the 10-bit infrared sensitivity (counts/K) and the dynamic range for a selected period in the middle of each flight. The sensitivity values represent the number of raw count values recorded for a given scene temperature change of 1 K using 10-bit data. Infrared channel sensitivity is non-linear in temperature and decreases with decreasing scene temperature. Initial dynamic range values were adjusted by changing the gain and offset settings during the first couple of flights, and by the September 19 flight, they had stabilized.

The single sample noise (or NEΔT) in observed imagery can be calculated two ways. First, the single sample noise can be estimated with the use of structure functions (Hillger and Vonder Haar 1988; Jedlovec 1987; Hillger and Vonder Haar 1979). This approach has a wide application since it does not require a perfectly uniform scene. Second, the variance can be computed directly over a uniform scene to estimate the single sample noise in the radiance data. In the latter case, a uniform thermal scene (such as a large water body) is usually required. Therefore, the computed variance is directly related to the channel noise. A comparison that shows the consistency of each method is presented by Jedlovec et al. (1989).

The structure function method has been used with CAMEX data because of its more general application to a variety of scene data. Single sample noise estimates are shown in Table 4. In most cases regions over the ocean or lakes were selected for these computations; however, when the scene temperature was too warm for the channel 10 dynamic range, a cloudy scene was chosen. The effect of choosing a cloudy region is to overestimate the noise in the channel, since a varying cloud emissitivity will induce effective brightness temperature variations. As a result of the 10-bit data, the channel sensitivity is greater than the noise; therefore, a realistic single sample noise can be obtained. MAMS single sample noise values are generally < 0.10 K in channels 10-12 and ~0.16 K in channel 9.

Noise in the calibration data can also be a problem in the use of the data. The noise manifests itself as line-to-line variations in the image data. The amplitude of these variations depends on the magnitude of the noise and the specific scene temperature. Jedlovec et al. (1986a, 1989) have shown for MAMS data that the noise is not always random but can be coherent. The only day with notable noise in the calibration data is September 26.

Three other problems were found while scrutinizing the data: an apparent absolute calibration problem in infrared channels on September 26, a "bright zone" in channel 9 during several of the flights, and occasional radio interference in some channels. The "bright zone" is defined as a region (~2/3 the swath width) where the brightness temperatures are noticeably colder than the rest of the swath.

Table 3. MAMS infrared channel sensitivity and dynamic range.

Date	Channel	Wavelength (μm)	Sensitivity 10 bit (counts/K) Scene Temperature (K) 225	250	275	300	Dynamic Range (K)
Sept. 11							
	9	6.5	4.0	8.5	16.0	-	0 - 288
	10	11.1	-	-	-	-	-
	11	11.1	5.1	7.5	10.0	12.5	207 - 320
	12	12.5	-	13.8	17.4	21.1	243 - 302
Sept. 12			NO DATA				
Sept. 15							
	9	6.5	3.5	7.4	13.3	-	0 - 290
	10	11.1	7.3	10.8	14.3	-	156 - 289
	11	11.1	5.1	7.4	9.8	12.1	204 - 321
	12	12.5	-	10.8	13.8	16.7	233 - 309
Sept. 19							
	9	6.5	3.6	7.7	13.8	-	0 - 290
	10	11.1	5.6	8.0	10.8	-	0 - 291
	11	11.1	5.4	7.8	10.5	13.3	209 - 318
	12	12.5	-	11.4	14.8	17.4	234 - 307
Sept. 25							
	9	6.5	3.6	7.4	13.8	-	0 - 290
	10	11.1	5.1	7.2	10.0	-	0 - 293
	11	11.1	4.8	7.0	9.5	11.8	197 - 322
	12	12.5	-	10.5	13.3	16.0	230 - 310
Sept. 26							
	9	6.5	3.5	7.1	13.3	-	0 - 291
	10	11.1	5.7	8.2	10.8	-	0 - 291
	11	11.1	5.4	7.7	10.3	12.9	208 - 318
	12	12.5	-	11.4	14.3	17.4	235 - 307
Sept. 29			NO DATA				
Sept. 30							
	9	6.5	3.4	7.4	13.8	-	0 - 291
	10	11.1	5.6	8.2	10.8	-	0 - 291
	11	11.1	5.4	7.8	10.5	13.3	209 - 318
	12	12.5	-	11.4	14.3	17.4	235 - 307
Oct. 3							
	9	6.5	3.6	7.1	13.8	-	0 - 291
	10	11.1	5.6	8.0	10.8	-	0 - 291

Table 3. Concluded

Date	Channel	Wavelength (μm)	Sensitivity 10 bit (counts/K) Scene Temperature (K) 225	250	275	300	Dynamic Range (K)
Oct. 3	11	11.1	5.3	7.8	10.3	12.9	208 - 318
	12	12.5	-	11.1	14.3	17.4	233 - 308
Oct. 5							
	9	6.5	3.4	7.1	13.3	-	0 - 290
	10	11.1	5.9	8.5	11.4	-	0 - 289
	11	11.1	5.6	8.0	10.8	13.8	209 - 316
	12	12.5	-	11.1	14.3	17.4	231 - 307
Oct. 7							
	9	6.5	3.2	7.0	12.9	-	0 - 293
	10	11.1	5.6	6.8	9.1	-	0 - 299
	11	11.1	4.4	6.5	8.7	10.8	201 - 330
	12	12.5	-	9.5	12.1	14.8	233 - 317

Table 4. Single sample noise estimates for the infrared channels.

Date	Channel	Wavelength (μm)	Scene Temperature (K)	NEΔT (K)
Sept. 11	9	6.5	242.2	0.14
	10	11.1	-	-
	11	11.1	286.1	< 0.10
	12	12.5	285.1	< 0.10
Sept. 12		NO DATA		
Sept. 15	9	6.5	249.0	0.15
	10	11.1	288.7	< 0.10
	11	11.1	294.3	< 0.10
	12	12.5	291.7	< 0.10
Sept. 19	9	6.5	243.3	0.15
	10	11.1	286.0	< 0.10
	11	11.1	299.6	< 0.10
	12	12.5	294.0	< 0.10
Sept. 25	9	6.5	228.7	0.24
	10	11.1	274.6	0.14
	11	11.1	274.5	0.15
	12	12.5	264.2	0.17
Sept. 26	9	6.5	248.1	0.16
	10	11.1	215.2	0.73
	11	11.1	300.4	< 0.10
	12	12.5	297.9	< 0.10
Sept. 29		NO DATA		
Sept. 30	9	6.5	245.3	0.17
	10	11.1	237.2	0.12
	11	11.1	296.1	< 0.10
	12	12.5	291.5	< 0.10
Oct. 3	9	6.5	244.9	0.16
	10	11.1	208.8	0.16
	11	11.1	295.6	< 0.10
	12	12.5	291.8	< 0.10
Oct. 5	9	6.5	251.0	0.14
	10	11.1	216.4	0.21
	11	11.1	297.0	< 0.10
	12	12.5	292.9	< 0.10
Oct. 7	9	6.5	227.4	0.43
	10	11.1	290.1	< 0.10
	11	11.1	290.0	< 0.10
	12	12.5	285.8	0.14

Data Availability

The MAMS has a very high data rate which exceeds 200 megabytes of data per hour. These data are currently recorded on 8 mm Exabyte tapes during the flight. These Exabyte tapes are permanently archived at NASA's Ames Research Center at Moffett Field, California. Limited amounts of MAMS data were processed and evaluated in the field after each flight. This evaluation served as the basis for gain changes from one flight to the next. All MAMS data collected during CAMEX can be obtained from Ames in raw form (uncalibrated - level 0 data). The focal point for requesting these data is:

Jeff Myers
High Altitude Missions Branch
NASA/Ames Research Center
Mail Stop 240-6
Moffett Field, CA 94035
415-694-6252

MSFC has obtained all of the MAMS data for CAMEX from Ames. Because of the volume of data and the number of data flights, these data will not be mass distributed or put in an active archive. Data for specific flights will be processed and made available on an individual request basis. It will be available in either raw or calibrated form on magnetic tape in either a McIDAS area data format or in a generic "flat" file format. Complete documentation of these formats will be provided upon request. For special case studies, higher level data may be available, including navigated and Earth located scenes and flight tracks. These scene data may be composed of either radiances or temperature data, and may include derived products such as integrated water content, upper level humidity, and cloud top temperatures. Scanner data and products produced at MSFC can be requested through:

Anthony R. Guillory
Earth System Observing Branch/ES43
NASA/Marshall Space Flight Center
Huntsville, AL 35812
205-544-6462

REFERENCES

Bradshaw, J. T., and H. E. Fuelberg, 1993: An evaluation of high-resolution interferometer soundings and their use in mesoscale analyses. *J. Appl. Meteor.*, **32**, 522-538.

Griffin, V. L., A. R. Guillory, M. Susko, and J. E. Arnold, 1994: Convection And Moisture Experiment (CAMEX) Operations Summary. NASA TM, in preparation.

Guillory, A. R., G. J. Jedlovec, and H. E. Fuelberg, 1993: A technique for deriving column-integrated water content using VAS split-window data. *J. Appl. Meteor.*, **32**, 1226-1241.

Guillory, A. R., and G. J. Jedlovec, 1994: A mesoscale moisture analysis of a Florida sea breeze from CaPE. Preprints, *Sixth Conf. on Mesoscale Processes*, AMS, Portland, OR, in preparation.

Hillger, D. W., and T. H. Vondar Haar, 1979: An analysis of satellite infrared soundings at the mesoscale using statisical structure and correlation functions. *J. Atmos. Sci.*, **36**, 287-305.

Hillger, D. W., and T. H. Vonder Haar, 1988: Estimating noise levels of remotely sensed measurements from satellites using spatial structure analysis. *J. Atmos. Ocean. Tech.*, **5**, 206-214.

Jedlovec, G. J., 1984: Mesoscale analysis of 6.7 micron image data from the VISSR Atmospheric Sounder (VAS) for several case studies. Preprints, *Conf. on Satellite Meteorology/Remote Sensing and Applications*, AMS, Boston, MA, pp. 185-190.

Jedlovec, G. J., 1987: Determination of atmospheric moisture structure from high resolution MAMS radiance data. Ph.D. Dissertation, University of Wisconsin-Madison, 173 pp. [available University Microfilms International, 300 North Zeeb Road, Ann Arbor, MI 48106]

Jedlovec, G. J., 1989: Estimation of thermal flux and emissivity of the land surface from multispectral aircraft data. *Proceedings of IGARSS '89: 12th Canadian Symposium on Remote Sensing*, Vancover, Canada, IEEE, **3**, 1783-1786.

Jedlovec, G. J., 1990: Precipitable water estimation from high-resolution split window radiance measurements. *J. Appl. Meteor.*, **29**, 863-877.

Jedlovec, G. J., 1992: MAS1 data evaluation -- Azores ferry flights. unpublished paper, 11 pp.

Jedlovec, G. J., and R. J. Atkinson, 1993: Calibration, navigation, and registration of MAMS data for FIFE. NASA TM-108397, 49 pp.

Jedlovec, G. J., and G. S. Carlson, 1994: Guess dependence of the physical split window technique for the retrieval of integrated water content. Preprints, *Seventh Conf. on Satellite Meteorology and Oceanography*. AMS, Monterey, CA, in preparation.

Jedlovec, G. J., W.P. Menzel, R.J. Atkinson, and G.S. Wilson, 1986a: The Multispectral Atmospheric Mapping Sensor (MAMS): Instrument Description, Calibration, and Data Quality. NASA TM-86565, 37 pp. [available NTIS].

Jedlovec, G. J., W. P. Menzel, G. S. Wilson, and R. J. Atkinson, 1986b: Detection of mountain induced mesoscale wave structures with high resolution moisture imagery. Preprints, *Second Conf. on Satellite Meteorology/Remote Sensing and Applications*, AMS, Boston, MA, pp. 365-369.

Jedlovec, G. J., K. B. Batson, R.J. Atkinson, C.C. Moeller, W.P. Menzel, and M.W. James, 1989: Improved capabilities of the Multispectral Atmospheric Mapping Sensor MAMS). NASA TM-100352, 80 pp. [available NTIS N89-20430]

King, M., and D. Herring, 1992: The MODIS Airborne Simulator (MAS). *The Earth Observer*, **4**, 15-19.

Menzel, W. P., G. J. Jedlovec, and G. S. Wilson, 1986: Verification of small scale features in VAS imagery using high resolution MAMS imagery. *Second Conf. on Satellite Meteorology/Remote Sensing and Applications*, AMS, Williamsburg, VA, pp. 108-111.

Moeller, C. C., L. E. Gumley, K. I. Strabala, and W. P. Menzel, 1989: High resolution depiction of SST and SSC from MAMS data. *Fourth Conf. on Satellite Meteorology and Oceanography*, AMS, San Diego, CA, pp. 208-212.

Moeller, C. C., K. I. Strabala, and W. P. Menzel, 1993: High resolution depiction of atmospheric moisture, stability, and surface temperature from combined MAMS and VAS radiances. *Int. J. Remote Sensing*, **14**, 1133-1158.

APPROVAL

MAMS DATA FOR THE CONVECTION AND MOISTURE EXPERIMENT (CAMEX)

By

A. R. Guillory, G. J. Jedlovec, and R. J. Atkinson

This report has been reviewed for technical accuracy and contains no information concerning national security or nuclear energy activities or programs. The report, in its entirety, is unclassified.

Gregory S. Wilson
Director, Space Sciences Laboratory

☆ U.S. GOVERNMENT PRINTING OFFICE 1994 533–108 /00014